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IS 11960 (1987): Methods for metallographic determination of apparent porosity and uncombined carbon in hardmetals [MTD 25: Powder Metallurgical Materials and Products]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard
METHOD FOR
METALLOGRAPHIC DETERMINATION OF
APPARENT POROSITY AND UNCOMBINED
CARBON IN HARD METALS

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NEW DELHI 110002

Indian Standard

METHOD FOR METALLOGRAPHIC DETERMINATION OF APPARENT POROSITY AND UNCOMBINED CARBON IN HARD METALS

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Indian Standard

METHOD FOR METALLOGRAPHIC DETERMINATION OF APPARENT POROSITY AND UNCOMBINED CARBON IN HARD METALS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 20 February 1987, after the draft finalized by the Powder Metallurgical Materials and Products Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 With the increasing use of hardmetals, a need has been felt for having standards on the metallographic examination. This standard is one of the series on the subject. It is hoped that the formulation of this standard will be of considerable use to the industry.

0.3 In the preparation of this standard, assistance has been derived from the following standards:

ISO 4505-1978 Hardmetals — Metallographic determination of porosity and uncombined carbon. International Organization for Standardization (ISO).

ASTM B 276-79 Test method for apparent porosity in cemented carbides. American Society of Testing and Materials.

0.4 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies the procedure for the metallographic determination of the presence, type and distribution of porosity and uncombined carbon in hardmetals.

2. APPARATUS

2.1 Metallographic Microscope — or other suitable equipment permitting observations and measurements up to a magnification of $200\times$.

2.2 Equipment — for the metallographic preparation of test specimens.

3. SPECIMEN PREPARATION

3.1 The specimen shall be selected and prepared for metallographic examination as per IS : 11520-1985*.

3.2 The surface to be examined shall be unetched and free from grinding and polishing marks. Care shall be taken to avoid tearing out of particles, which may lead to a wrong evaluation of porosity.

4. PROCEDURE

4.0 Pore size is defined as the maximum dimension of the pore in the section. Special reference shall be made to the presence of cracks or slits.

*Method for metallographic sample preparation of hardmetals.

4.1 Pore up to $10\text{ }\mu\text{m}$ shall be assessed by scanning the surface of the test piece section at a magnification of either $100\times$ or $200\times$. An area fully representative of the test piece section shall be examined and compared with the range of photomicrographs shown in Fig. 1 or 2, according to the chosen magnification. The porosity level shall be reported by reference to the appropriate photomicrograph and designated as A02, A04, A06 or A08.

4.2 Pores within the range 10 to $25\text{ }\mu\text{m}$ shall be assessed by scanning the surface of the test piece section at a magnification of $100\times$. An area fully representative of the test piece section shall be examined and shall be compared with the range of photomicrographs shown in Fig. 3. The porosity level shall be reported by reference to the appropriate photomicrograph and designated as B02, B04, B06 or B08.

4.3 If it is necessary to inspect for pores larger than $25\text{ }\mu\text{m}$, they shall be examined at a suitable magnification up to $100\times$ and shall be counted and reported as the number of pores per unit area. The size ranges shall be chosen as follows: 25 to $75\text{ }\mu\text{m}$, 75 to $125\text{ }\mu\text{m}$, over $125\text{ }\mu\text{m}$.

4.4 Uncombined carbon shall be assessed by scanning the surface of the test-piece section at a magnification of $100\times$. An area fully representative of the test piece section shall be examined and shall be compared with the range of photomicrographs

shown in Fig. 4. The level of uncombined carbon shall be reported by reference to the appropriate photomicrographs and designated as C02, C04, C06 or C08.

4.5 If A or B type porosity or C type uncombined carbon is not detected, it shall be reported as A00, B00 or C00 as applicable.

4.6 If the porosity or uncombined carbon is not uniform over the area of the test piece section being examined, the locations on the section to which the evaluation refers must be identified, for

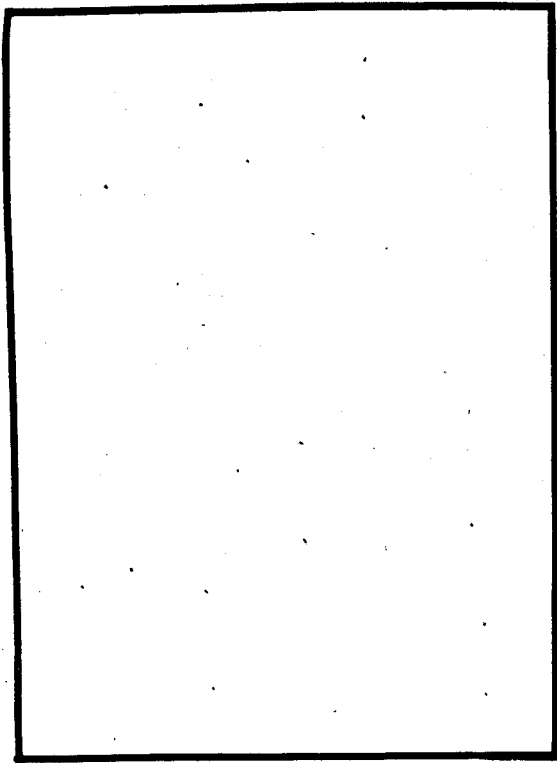
example as top, bottom, edge, rim (case), core, etc.

5. TEST REPORT

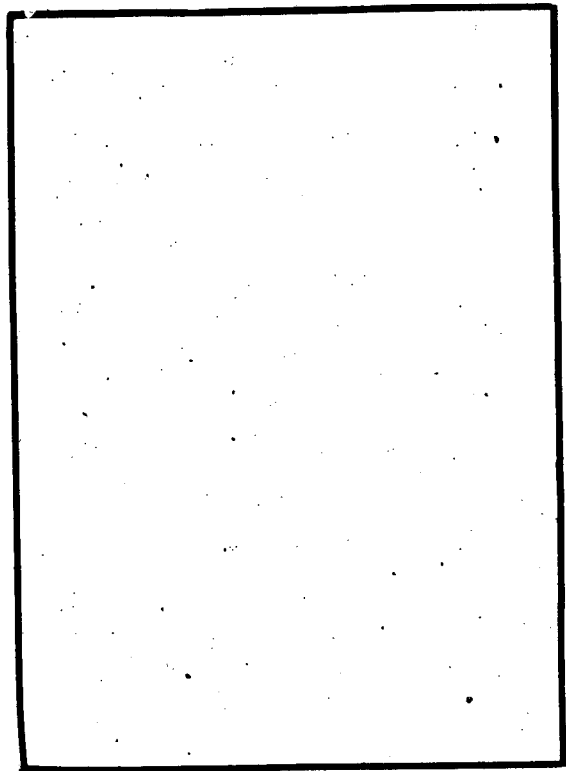
5.1 The test reports shall include the following information:

- a) Reference to this standard,
- b) Complete identification of the test specimen,
- c) The results obtained, and
- d) Details of any occurrence which may have affected the result.

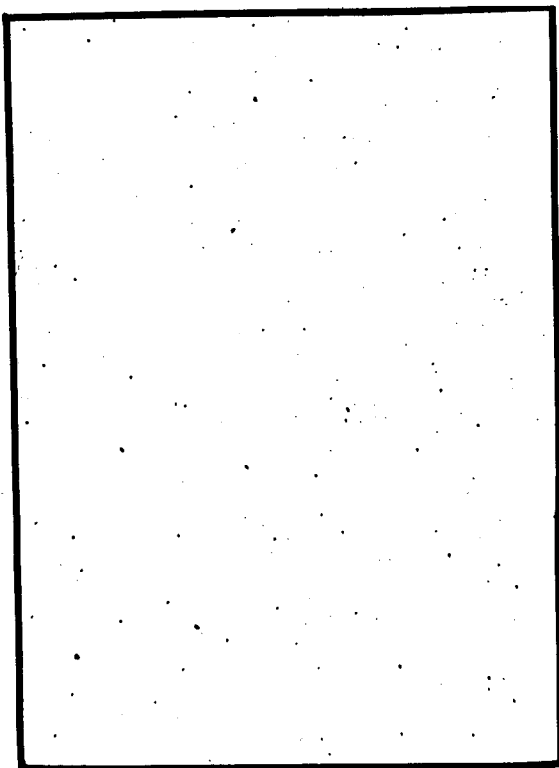
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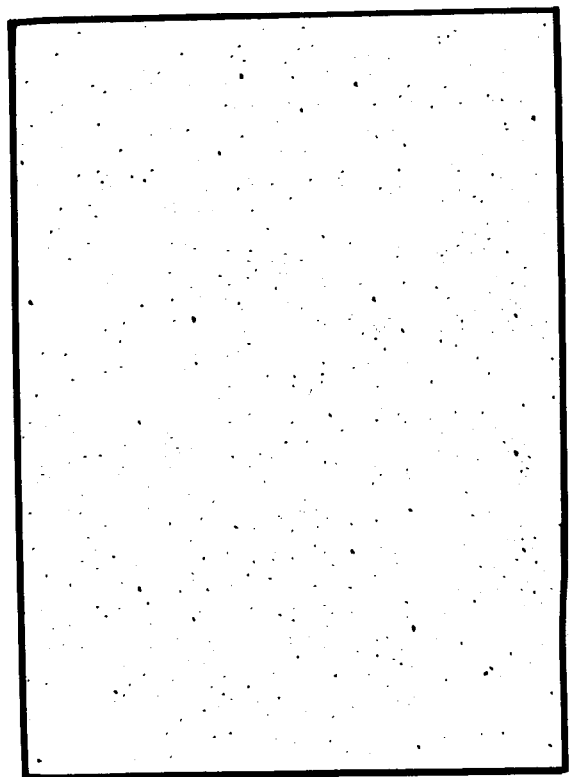
A02 0,02 % (vol.)



A04 0,06 % (vol.)

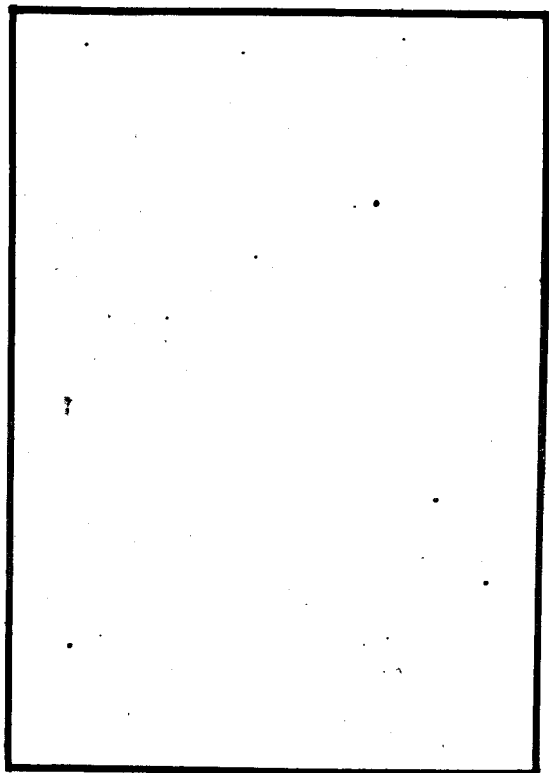


A06 0,2 % (vol.)

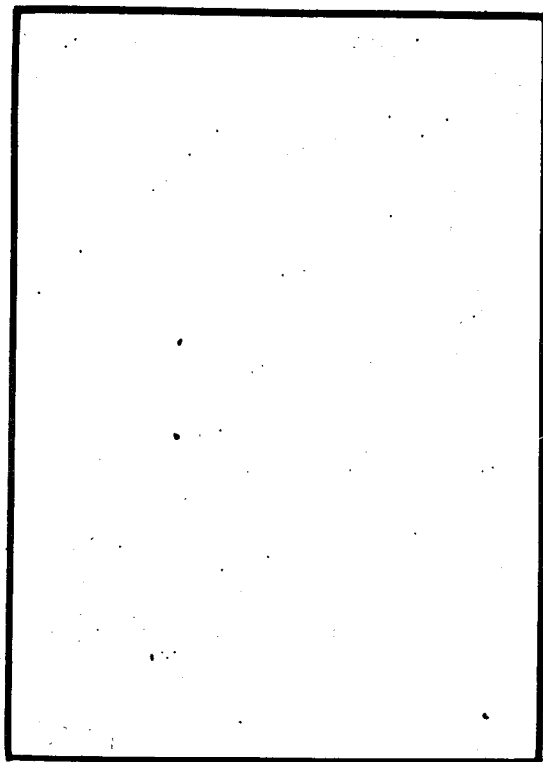


A08 0,6 % (vol.)

FIGURE 1 — Type A apparent porosity (X 100)
(This figure is reproduced from ISO 4505)



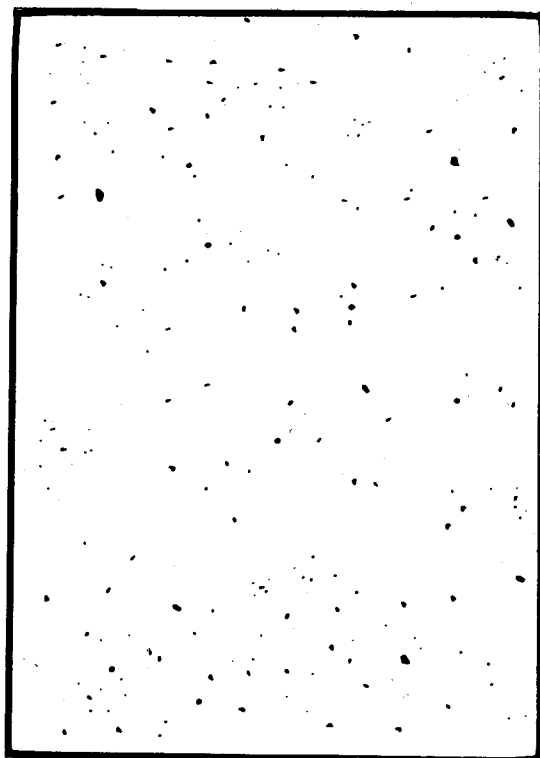
A02 0,02 % (vol.)



A04 0,06 % (vol.)

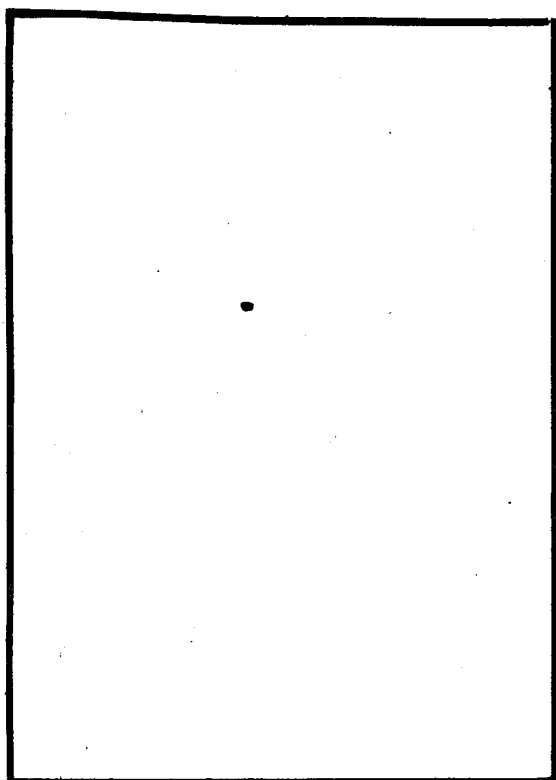


A06 0,2 % (vol.)

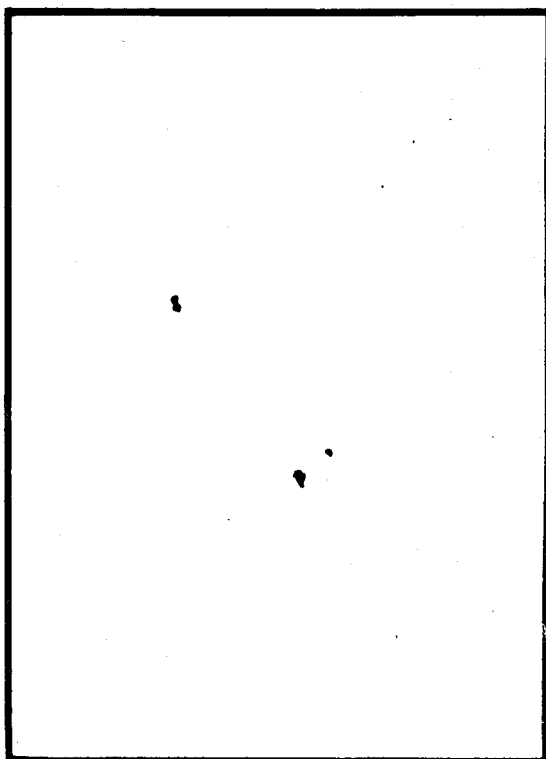


A08 0,6 % (vol.)

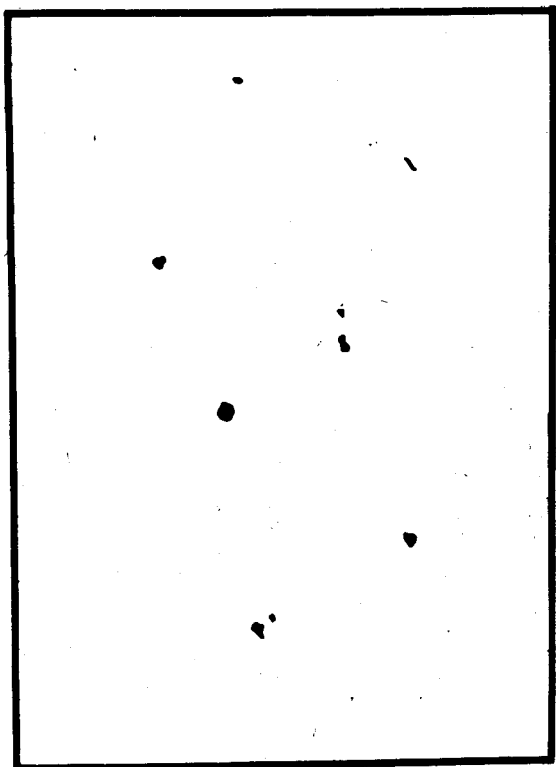
FIGURE 2 — Type A apparent porosity (X 200)
(This figure is reproduced from ISO 4505)



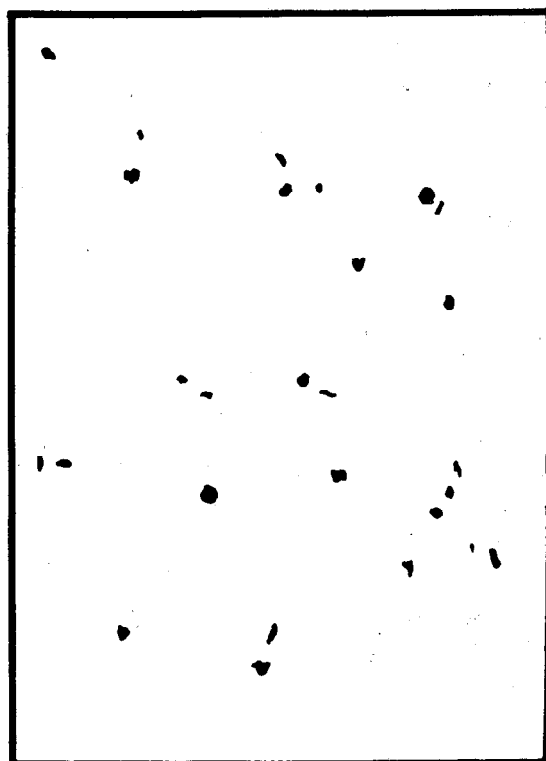
B02 0,02 % (vol.)
(140 pores/cm²)



B04 0,06 % (vol.)
(430 pores/cm²)

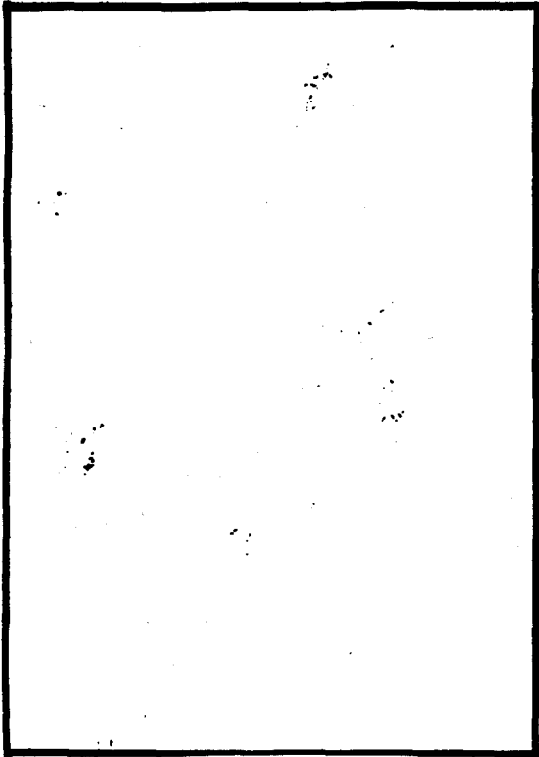


B06 0,2 % (vol.)
(1 300 pores/cm²)

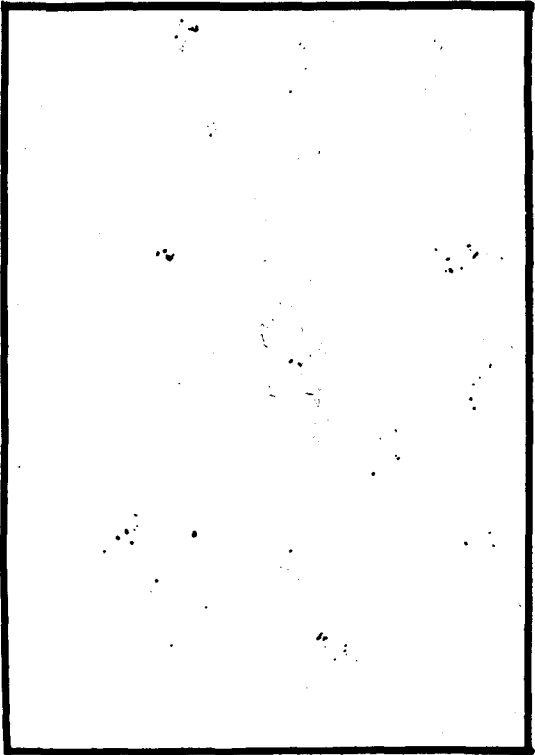


B08 0,6 % (vol.)
(4 000 pores/cm²)

FIGURE 3 — Type B apparent porosity (× 100)
(This figure is reproduced from ISO 4505)



C02



C04



C06



C08

FIGURE 4 — Uncombined carbon (X 100)
(This figure is reproduced from ISO 4505)